Cambridge Assessment International Education

Singapore-Cambridge O Level

CHEMISTRY **6092/02**

Paper 2 Theory **October/November 2024**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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Generic Marking Schemes

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): ● The response should be read as continuous prose, even when numbered answer spaces are provided. ● Any response marked ignore in the mark scheme should not count towards ***n***. ● Incorrect responses should not be awarded credit but will still count towards ***n***. ● Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should not be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. ● Non-contradictory responses after the first n responses may be ignored even if they include incorrect science.

6	Calculation specific guidance Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	Guidance for chemical equations Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	phosphorus / P	**1**
1(b)	chlorine / Cl	**1**
1(c)	nickel / Ni	**1**
1(d)	nitrogen / N **OR** sulfur / S **AND** oxygen / O	**1**
1(e)	aluminium / Al **OR** zinc / Zn **OR** gallium / Ga	**1**
1(f)	bromine / Br	**1**
1(g)	helium / He	**1**

Question	Answer	Marks
2(a)	$Cu^{2+} + 2e^- \rightarrow Cu$ (1) gets plated with copper (1)	**2**
2(b)(i)	1.21 (g)	**1**
2(b)(ii)	1.75 (g)	**1**
2(c)	purification of copper / making high grade copper **IGNORE:** uses of copper / for coating metals / for electroplating	**1**
2(d)	copper(II) ions preferentially discharged **AND** concentration decreases **AND** gets plated (1) hydroxide ions preferentially discharged to oxygen (1) hydrogen ions react with sulfate ions form sulfuric acid **OR** more hydrogen ions than hydroxide ions **AND** acidic (1)	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>
<table>
<tr><td>name</td><td>mass</td><td>charge</td></tr>
<tr><td>proton</td><td>1</td><td>+1</td></tr>
<tr><td>neutron</td><td>1</td><td>0</td></tr>
<tr><td>electron</td><td>any fraction between 1/1700 and 1/2000 for relative mass of electron</td><td>–1</td></tr>
</table>
(1) per correct column</td><td>2</td></tr>
<tr><td>3(b)</td><td>liquid AND isotope of hydrogen AND similar to water (1)</td><td>2</td></tr>
<tr><td>3(c)</td><td>D has 6 neutrons while E has 7 neutrons OR E has 1 more neutron than D (1)
D and E have 6 protons (1)</td><td>2</td></tr>
<tr><td>3(d)(i)</td><td>boron / B</td><td>1</td></tr>
<tr><td>3(d)(ii)</td><td>electrons should not be paired up OR electrons should be far apart in a shell (1)
electrons in different shells should not be near each other OR electrons should be far apart between shells (1)</td><td>2</td></tr>
<tr><td>3(e)</td><td>closely packed OR no spaces in between</td><td>1</td></tr>
</table>

Question	Answer	Marks
4(a)	$N_2 + 3H_2 \rightarrow / \rightleftharpoons 2NH_3$	**1**
4(b)	280°C **AND** 400 atm	**1**

Question	Answer	Marks
4(c)	increase speed of reaction (1) minimise cost (1)	**2**
4(d)	reactant level above product level **AND** ammonia (1) ΔH correctly labelled with arrow going downwards (1) **uncatalysed** activation energy correctly labelled with arrow / line going upwards (1) **catalysed** activation energy correctly labelled with arrow / line going upwards **AND** smaller than **uncatalysed** (1)	**4**

Question	Answer	Marks
5(a)	coating prevents oxygen and water from gaining electrons (1) attaching more reactive metal prevents iron atoms from oxidising (1) hydroxide ions and iron(II) ions do not collide / react **OR** oxygen does not oxidise iron(II) hydroxide (1)	**3**
5(b)	calculation for idea of dividing by correct A_r (1) e.g. (K) = 0.547/39, (Fe) = 0.195/56, (C) = 0.252/12, (N) = 0.294/14 for final formula only (1) e.g. $K_4FeC_6N_6$ or $K_4Fe(CN)_6$	**2**
5(c)(i)	(black) FeO **AND** (red-brown) Fe_2O_3	**1**
5(c)(ii)	(magnesium) magnesium reacts much faster (1) (magnesium) forms a white powder (1) (copper) no reaction (1)	**3**

Question	Answer	Marks
6(a)	marks only for the reasons for the choice of **poly(propene)** if any other polymer chosen, (0) for the section useable temperature is above 100°C (1) insoluble in oil (1)	**2**
6(b)	polythene used for cling film **OR** plastic bags	**1**
6(c)	higher molecular mass / size (1) stronger forces between molecules (1)	**2**
6(d)(i)	2 (–)C_2H_3Cl(–) + 5O_2 → 2HCl + 4CO_2 + 2H_2O	**1**
6(d)(ii)	no. of mole of unit = 28000000 / 62.5 = 448000 (mol) (1) volume = 448000 x 24 x 3 = 32300000 (dm^3) (1)	**2**

Question	Answer	Marks
7(a)(i)	(largely) supports (1) graphs are (roughly) similar **OR** high CO_2 matches high temperatures (1)	**2**
7(a)(ii)	melting of polar ice **OR** rise in sea levels (1) desertification (1) extreme climate changes/effect on animal/plant habitats (1)	**2**
7(b)	photosynthesis absorb CO_2 **AND** respiration release CO_2 (1) in same amounts (1)	**2**

Question	Answer	Marks
7(c)	values between 11.6 and 12.4 (actual value = 12) **AND** values between 15.2 and 16.0 (actual value = 15.6) (1) values between 22.6 and 37.9 (actual value = 30%) (1) increase in other greenhouse gases e.g. methane, hydrocarbons, water, sulfur dioxide	**3**

Question	Answer	Marks
8(a)	four valence electrons **AND** different number of atoms **OR** different bond orders (1) high energy to break strong covalent bonds (1) small size **AND** flexibility in arrangement of atoms (1)	**2**
8(b)(i)	graphite has fewer strong bonds to break	**1**
8(b)(ii)	exothermic as more bonds to be formed (1) slow rate as high activation energy **OR** graphite is stable **OR** high energy to break strong bonds (1)	**2**
8(c)	unreactive **OR** inert (1) small size **OR** atomic radius (1)	**2**
8(d)	high energy to break strong covalent bonds in giant molecular structure	**1**
8(e)	both have carbon atoms bonded to 3 carbon atoms (1) both have hexagonal rings (1) both have non-planar surfaces / both have curved edges (1) buckminsterfullerene is spherical but nanotubes is cylindrical (1) buckminsterfullerene is C_{60} but nanotubes has more carbon atoms (1)	**3**

Question	Answer	Marks
8(f)	delocalised electrons cannot move parallel to a layer	**1**

Question	Answer	Marks
9(a)	**A** = diesel oil; **B** = paraffin; **C** = naptha	**1**
9(b)	fractions vaporise / evaporate / boil (1) condense at different temperatures (1) lowest boiling points come out at highest point of tower / temperature highest at the bottom (1)	**3**
9(c)(i)	% carbon in hexadecane = 192 / 226 x 100 = 85.0% (1) % carbon in octane = 96 / 114 x 100 = 84.2% (1)	**2**
9(c)(ii)	$2C_{16}H_{34} + 49O_2 \rightarrow 32CO_2 + 34H_2O$	**1**
9(c)(iii)	higher percentage C **AND** more oxygen to combust (1) more likely incomplete combustion to form carbon monoxide / carbon (1)	**2**
9(d)	hydrogen **AND** (bio)ethanol	**1**

Question	Answer	Marks
10(a)(i)	breakdown of long chained hydrocarbons (into shorter / smaller chains) by high temperatures	**1**
10(a)(ii)	fractions which are less needed / exceed demand changed to those more needed / in greater demand (1) gas oil fraction converted to gasoline (1)	**2**
10(b)(i)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$	**1**
10(b)(ii)	addition **OR** hydration	**1**

Question	Answer	Marks
10(b)(iii)	number of moles of glucose = 18000 / 180 = 100 mol (1) theoretical mass of ethanol = 2 x 100 x 46 = 9.2 kg (1) % yield = 0.92 / 9.2 x 100 = 10% (1)	**3**
10(b)(iv)	process 1 makes more ethene (1) process 2 makes more C_8H_{18} (and so using both meets demand) (1)	**2**